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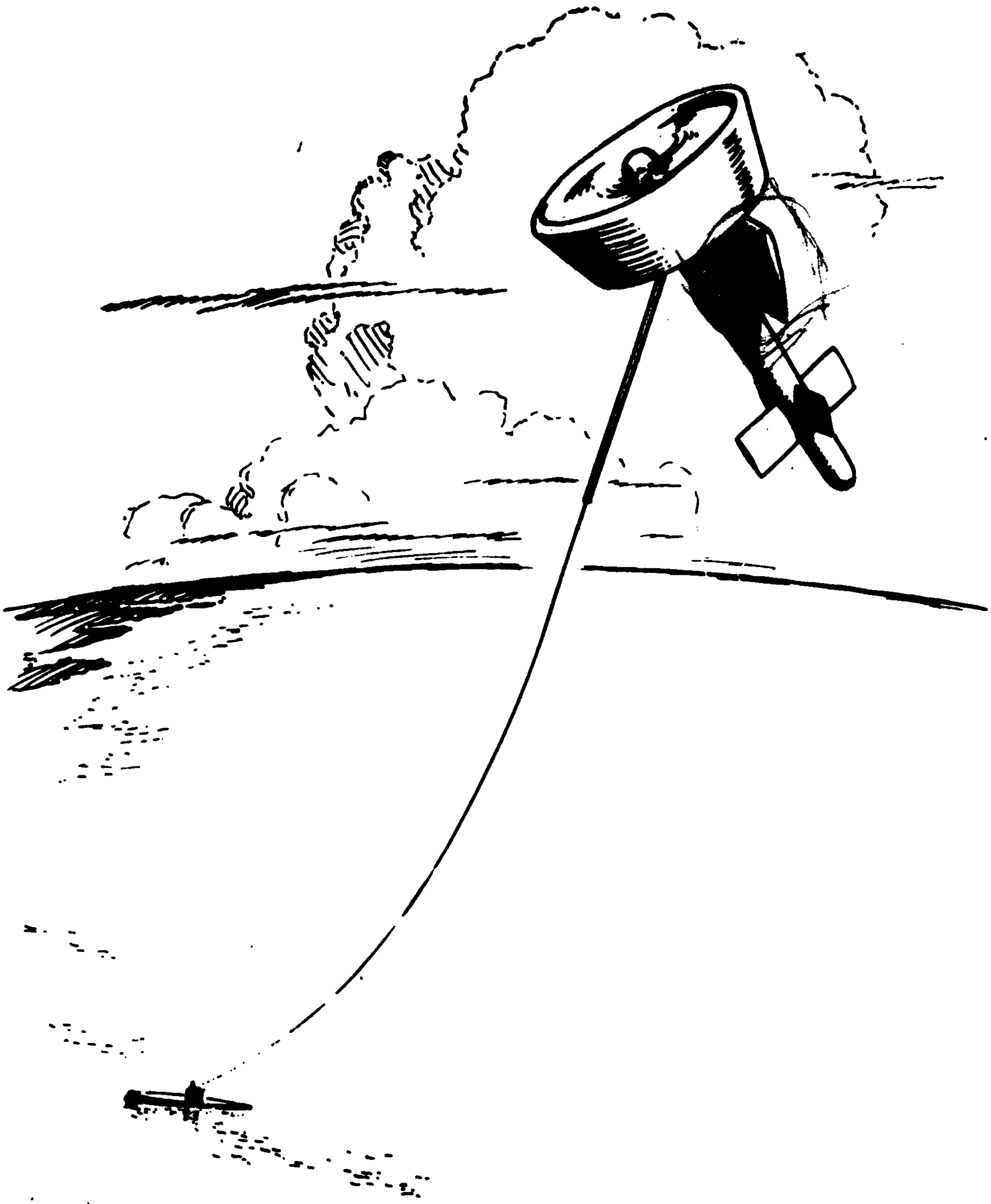

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Copy No. 2

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(9) BI-MONTHLY STATUS REPORT NO. 4.

JAN[redacted] - FEB[redacted]58,

7-8 NA

(6) TETHERED VERTICAL LIFT DEVICE.

(10) NA

(15) CONTRACT NOnr 1691(00)

(11) Feb 58,

(12) 19p.

(13) NA

16-19 NA

Placed by

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OFFICE OF NAVAL RESEARCH

DEPARTMENT of the NAVY

(21) NA

(14) ~~ALTOSCAN REPORT~~ NO. 118

ALTOSCAN COMPANY

45 W. Scottdale Road,

Lansdowne, Pennsylvania

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I. PURPOSE OF PROJECT

This is an engineering investigation incorporating the use of flying models to determine the optimum means of sustaining radar reflecting targets at altitude under a rather wide range of wind velocities. The specific requirements for the device are as follows:

(1) capable of hovering with full control while being tethered to a small surface craft;

(2) capable of attaining a maximum altitude of 500 feet above sea level while supporting a target weight of 25 pounds;

(3) capable of supporting a target weight of 25 pounds at 500 feet altitude with a wind of (30) knots and a ship speed of 25 knots;

(4) capable of hovering and forward speeds up to 55 knots;

(5) capable of continuous operation for a 24 hour period; and

(6) capable of being launched from a limited deck space.

Inasmuch as control and stability of the tethered lifting device are considered to present the major problems in this investigation and development project, a relatively high percentage of the contractors effort has been concentrated in these fields.

[redacted]

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II. STATUS OF DESIGN AND FABRICATION ACTIVITIES

All equipment and components are complete for the Phase I B Hovering Stability Tests. Circuit modifications are still being made in the control system to improve the operation of the TARD Gyro and its application to the shrouded propeller model. Various sizes and combination of wings were fabricated to conduct the deflected slip-stream tests.

[redacted]

[redacted]

III TEST ACTIVITIES

A. DISCUSSION

The concept of combining the ducted propeller and the deflected slipstream principals is intended to provide a configuration with the thrust axis tilted in relation to the ground in a no-wind condition. The amount of tilt will increase as the wind velocity increases. It is expected that such a configuration will raise or possibly eliminate the point in the velocity range where the pitching moment of the duct reverses, and it is further expected to eliminate or reduce transition problems. It is also expected that the tethering of this configuration will permit satisfactory maneuvering of the craft with control about two axis only.

B. ACTIVITIES COVERED BY THIS REPORT

1. The lack of full power and thrust reported in the previous Status Report was found to be due to improper adjustments of the motor generator unit. This situation has been corrected.
2. The major effort covered by this report consisted ~~of~~ static tests were run with both the 24-inch and 30-inch diameter ducts, mounted in suitable rigging to measure thrust, drag and moments. These tests were to run to investigate various methods of deflecting the slipstream of a ducted propeller and to obtain measurements of the magnitude and direction of the resultant lifting-

to pg 5

[redacted]

[redacted]

III TEST ACTIVITIES continued -

B. ACTIVITIES COVERED BY THIS REPORT continued -

2. continued -

from pg 3 force. Tests were also conducted to measure the effectiveness of the control surfaces and to investigate the airflow over the control surfaces when the slipstream is deflected by a wing. No conclusions have been drawn from these tests to date; however, the data obtained will be utilized in the actual flight testing program.

Various wing sections, areas, and high-lift devices have a wide range of values of L/D. It is also true that the more the slipstream is turned, the lower will be the value of L/D. The resultant of the thrust and the force derived from turning when expressed as R/T, offers a means of comparing the efficiency of the turning methods. The accompanying sketches (Fig. 10) illustrate the many different turning means tested and give the maximum value of R/T obtained. The selection of the turning means to be used in the flight test model has been based on the highest value of R/T for the amount of turning required by the configuration.

3. The tail portion of the fuselage with the transmission, control surfaces and gyro unit intact was suspended in a two axis gimbal ring. The transmission was driven by an electric motor attached at the forward end of the

[redacted]

III TEST ACTIVITIES continued -

B. ACTIVITIES COVERED BY THIS REPORT continued -

3. continued -

fuselage. This rig was used as a bench test of the complete control system, and to make initial adjustments of the gyro authority and ground control units prior to actual flight testing.

[redacted]

IV ACTIVITY FOR NEXT PERIOD

Actual flight test are to be started with freedom in one plane only and without deflection of slipstream. As work progresses, the model will be released in two planes of motion and deflection of the slipstream will be incorporated.

[redacted]

[redacted]

LIST OF FIGURES

Figure No.	Description
1 and 2.	Photograph of general test set-up using 24" duct. Data obtained in this set-up included power absorbed, combined thrust of duct and propellers, lift and drag of deflecting devices. End plates are outside of slipstream.
3.	Photograph showing arrangement with end plates inside slipstream.
4.	Photograph showing airfoil with fixed flap and ramps.
5.	Photograph of installation of two airfoils with fixed flaps and ramps.
6.	Front photograph of two airfoils with fixed flaps and ramps with stagger.
7.	Photograph of test set-up incorporating curved deflector plate.
8.	Photograph of static test set-up with 30" duct used to measure thrust of the duct and propeller along with moments of the tail surfaces and the deflector wing.
9.	Photograph of tufts showing effect of deflector wing on airflow over tail surfaces.
10.	Schematic sketches of test set-up to investigate various deflector arrangements with range of variable investigated and R/T results.
XA-3-275	Drawing illustrating overall dimension of flight test model.
XA-3-277	Drawing illustrating expected normal altitude of flight test model in wind.

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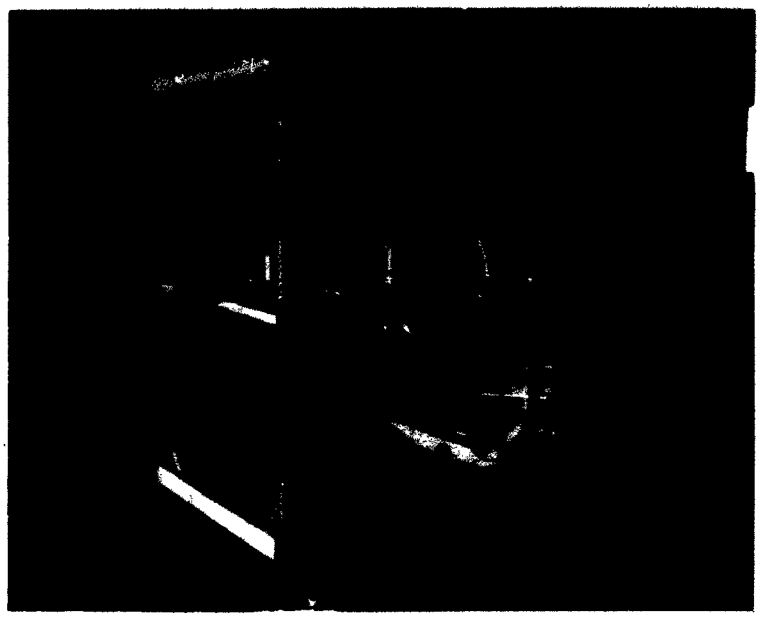

Figure No. 1

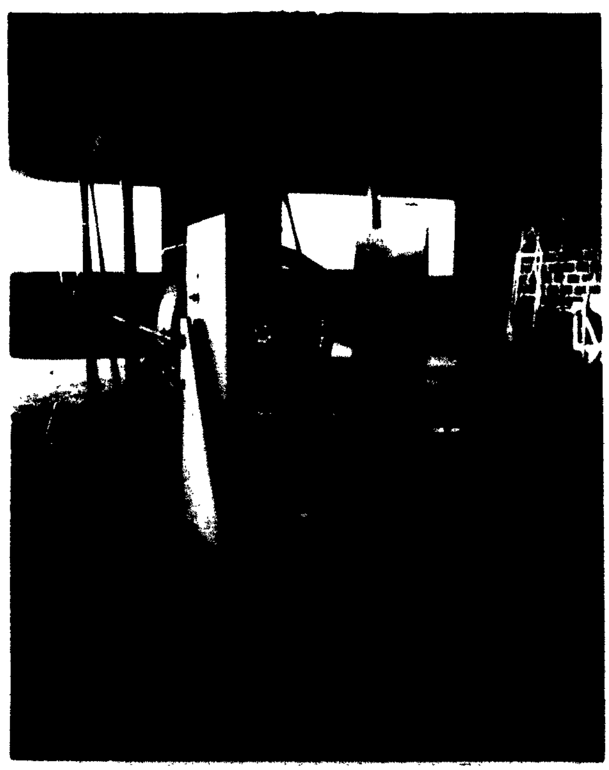

Figure No. 2

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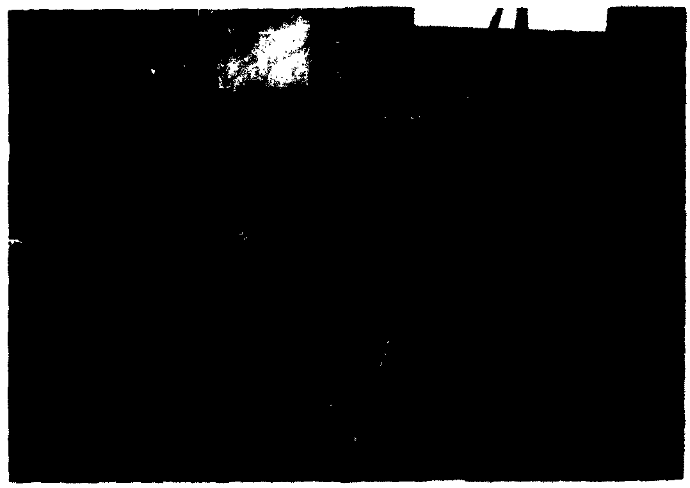

Figure No. 3

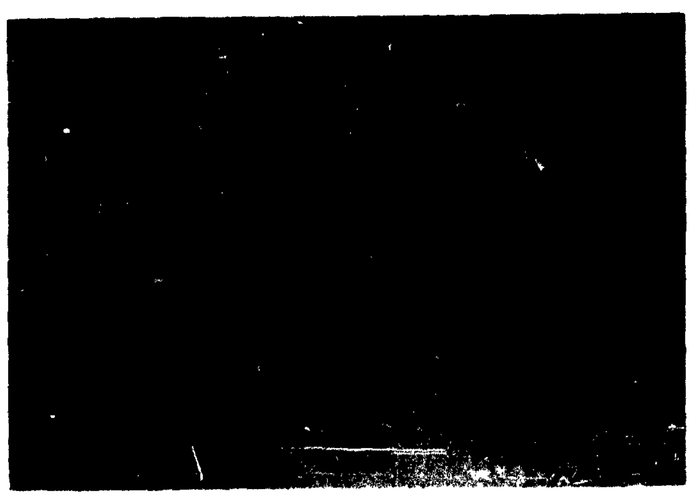

Figure No. 4

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Figure No. 5

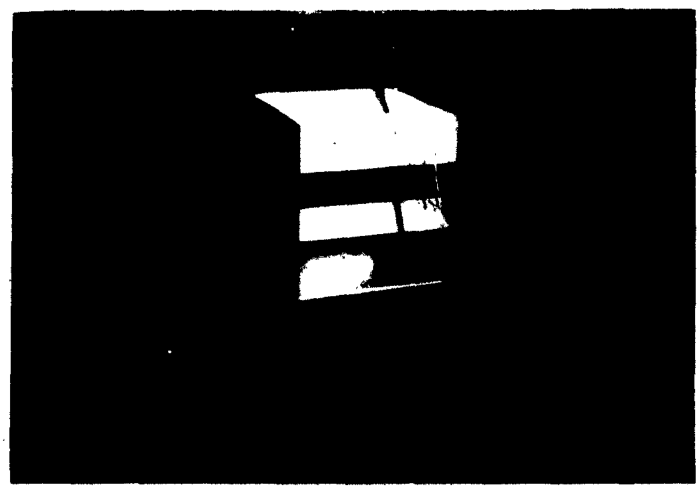

Figure No. 6

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Figure No. 7

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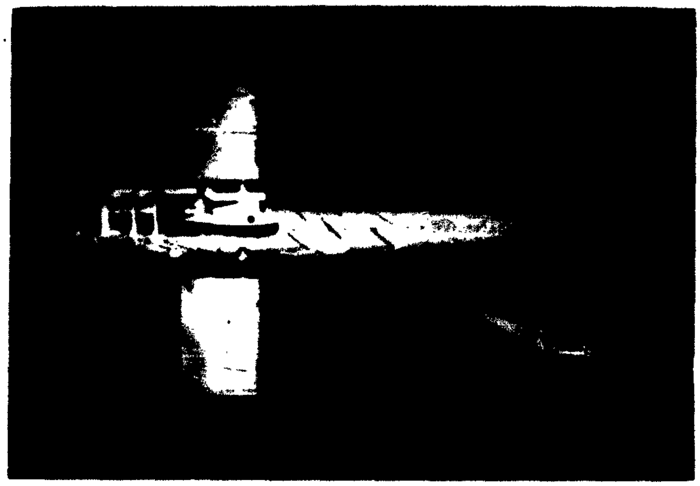

Figure No. 9

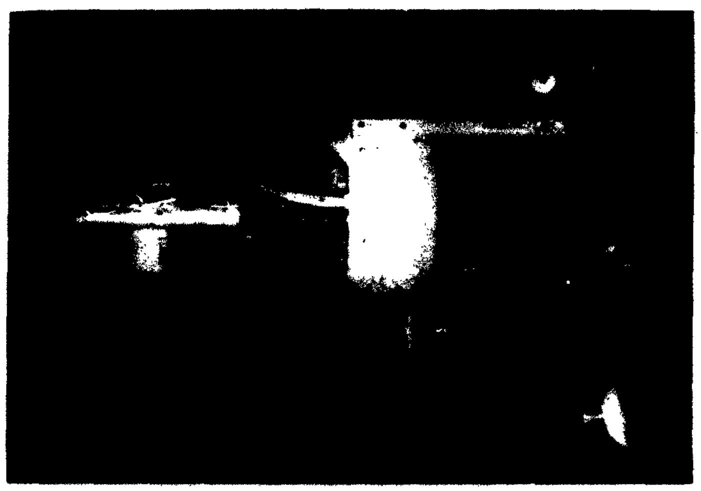

Figure No. 8

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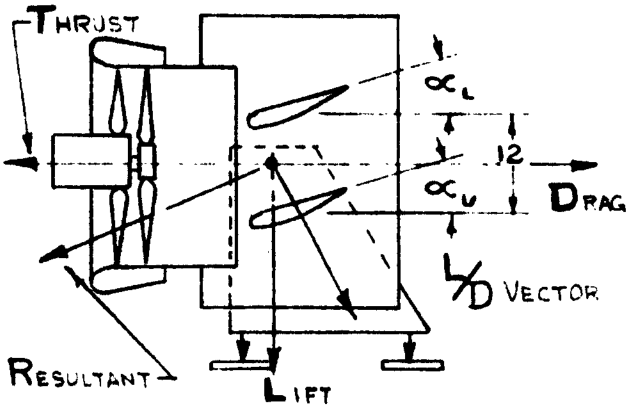


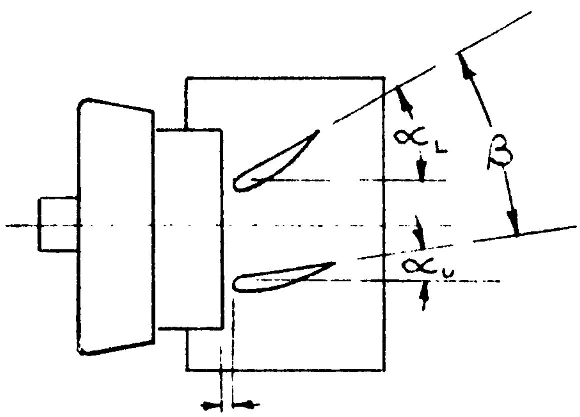
TEST RUN 1-13

End plates <u>outside</u> slipstream

Chord = 8" Span = 26"

$\alpha_L = \alpha_U$ and varying betw. 10°-35°

Max R/T @ $\alpha = 20^\circ$ = 99.4%.



TEST RUN 14-17

End plates <u>outside</u> slipstream

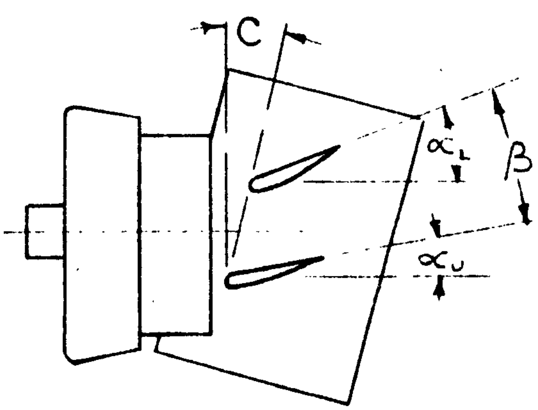
$\alpha_L = 13^\circ$ to 19°

$\alpha_U = 11^\circ$ to 17°

$\beta = -4^\circ$ to $+8^\circ$

With α_L @ 11° and $\beta = 8^\circ$

Max R/T = 98.5%



TEST RUN 18-35

End plates <u>outside</u> slipstream

$\alpha_L = 13^\circ$ to 19°

$\alpha_U = 11^\circ$ to 17°

$\beta = -4^\circ$ to $+8^\circ$

$C = -30^\circ$ to $+20^\circ$

With α_L @ 15°, β @ 0°, C @ -10°

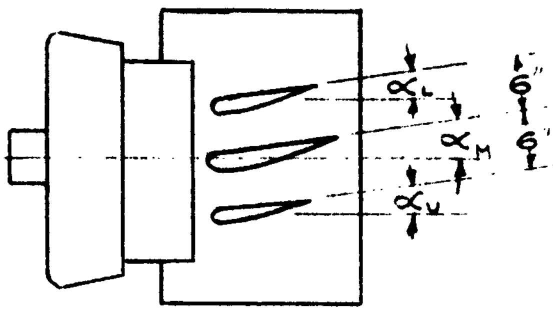
Max R/T = 99.9%

Figure 10-a

[redacted]

[redacted]

TEST RUN 36-41



End plates outside slipstream

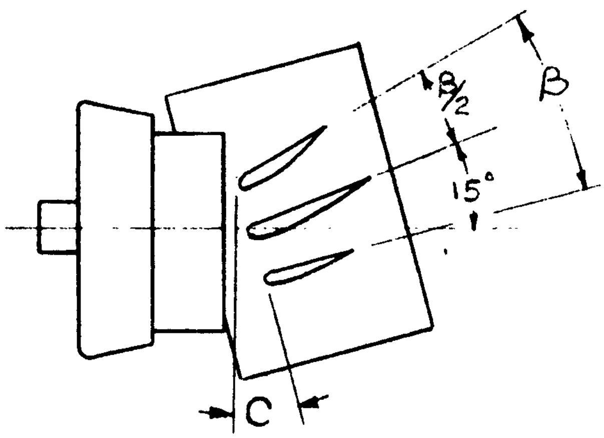
Chord L and U = 8" Chord M = 12"

$\alpha_L = \alpha_M = \alpha_U$ varying betw. 10° - 20°

With α @ 10°

Max R/T = 99.9%

TEST RUN 42-51



End plates outside slipstream

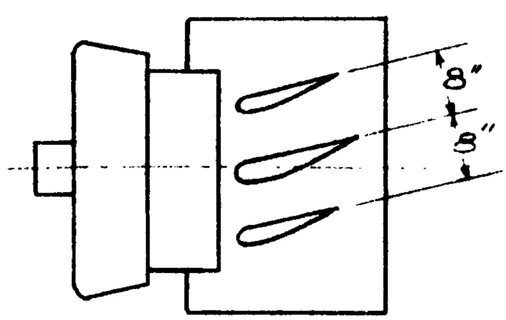
β = -8° to + 8°

C = -20°

With β @ + 4°

Max R/T = 98.8%

TEST RUN 52-55



End plates outside slipstream

$\alpha_L = \alpha_U = \alpha_M$ varying betw. 10° - 25°

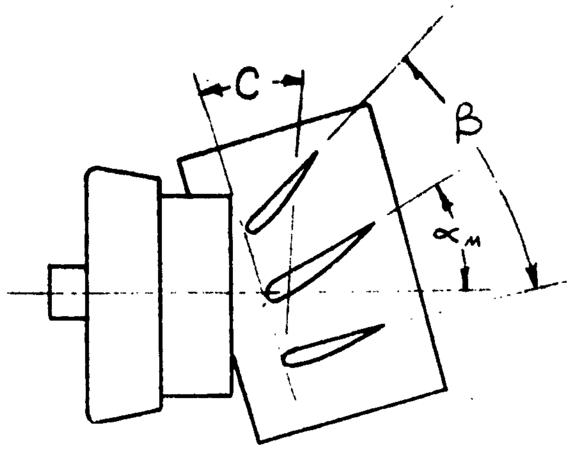
With α @ 10°

Max R/T = 99%

Figure 10-b

[redacted]

[redacted]



TEST RUN 56-62

End plates outside slipstream

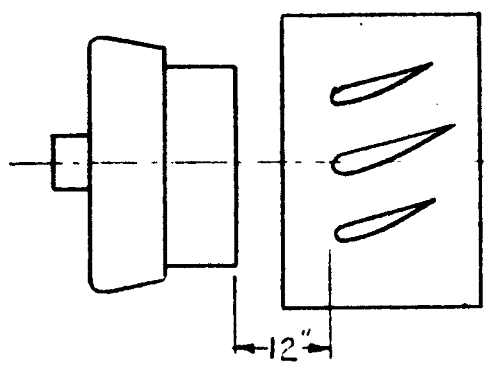
α_M varying from 15° to 20°

C varying from -20° to -40°

β varying from -8° to + 8°

With α @ 15°

Max R/T = 99.9%



TEST RUN 63-66

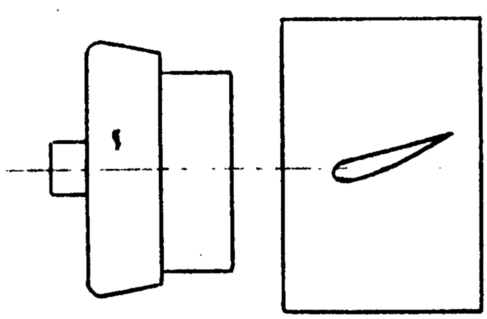
End plates outside slipstream

$\alpha_L = \alpha_M = \alpha_U$

α varying from 10° to 25°

With α @ 10°

Max R/T = 99%



TEST RUN 67-73

End plates outside slipstream

α_M varying from 10° to 35°

With α @ 10°

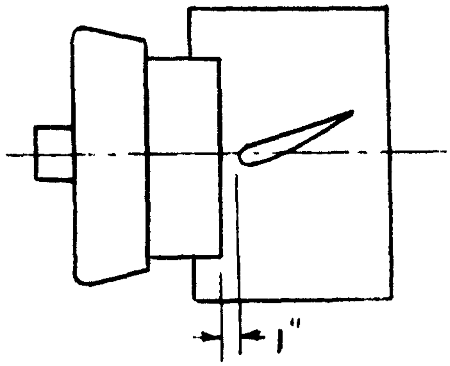
Max R/T = 99.2%

Figure 10-c

[redacted]

[redacted]

TEST RUN 74-79



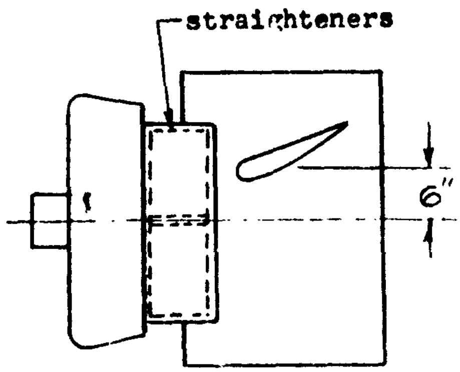
End plates outside slipstream

α_M varying from 10° to 35°

With α @ 15°

Max R/T = 98.9%

TEST RUN 80-95



End plates outside slipstream

With and without straightener vanes

in slipstream forward of wing.

α_L varying from 10° to 35°

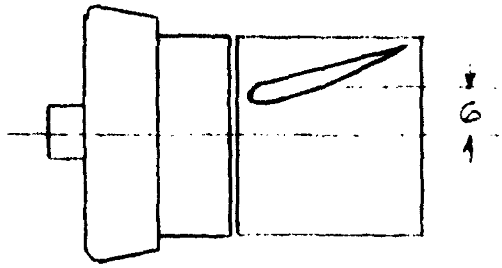
With α @ 10°

Max R/T = 99.9%

Figure 10-d

[redacted]

[redacted]



TEST RUN 96-102

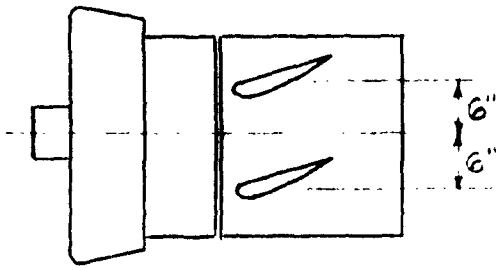
End plates in slipstream

Span = 17.5"

α_L varying from 10° to 30°

With α @ 20°

Max R/T = 99.8%



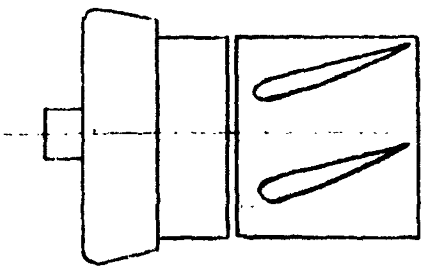
TEST RUN 103-109

End plates in slipstream

$\alpha_L = \alpha_U$, varying betw. 10° and 30°

With α = 10°

Max R/T = 97.3%



TEST RUN 110-118

End plates in slipstream

Chord = 22"

$\alpha_L = \alpha_U$ varying betw. 10° to 20°

With α = 10°

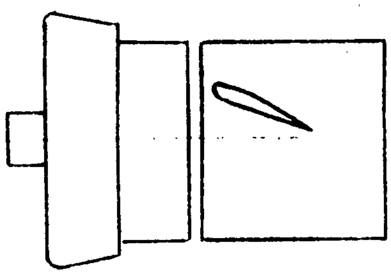
Max R/T = 96%

Figure 10-e

[redacted]

[redacted]

TEST RUN 119-125



End plates in slipstream

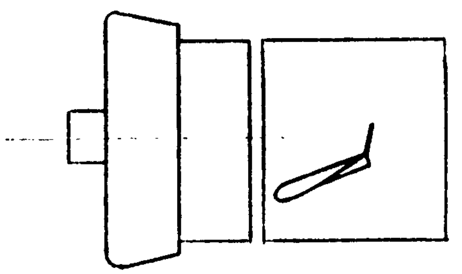
Chord = 12"

α_u varying from 10° to 28°

With α @ 17-1/2°

Max R/T = 96.9%

TEST RUN 126-139



End plates in slipstream

Fixed T.E. flap @ -45°

Ramps on upper surface

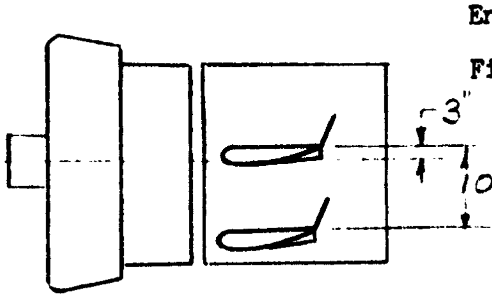
Chord (without flap) = 12"

α_m varying from 5° to 25°

With α @ 5°

Max R/T = 90.9%

TEST RUN 140-161



End plates in slipstream

Fixed T.E. flap @ -45°

Ramps on upper surface

Chord (without flap) = 12"

α_L varying from 0° to 38°

α_m varying from 0° to 12-1/2°

C varying from 0° to 12-1/2°

With α @ 0° and C = 0°

Max R/T = 88.5%

Figure 10-f

[redacted]

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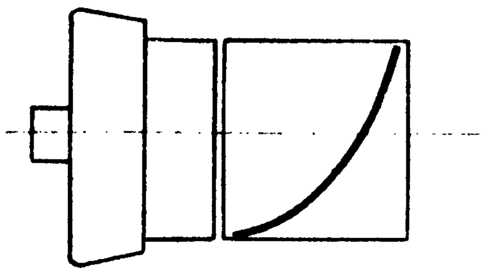
TEST RUN 162



End plates in slipstream

Curved deflector plates only

Max R/T = 75.5%

Figure 10-g

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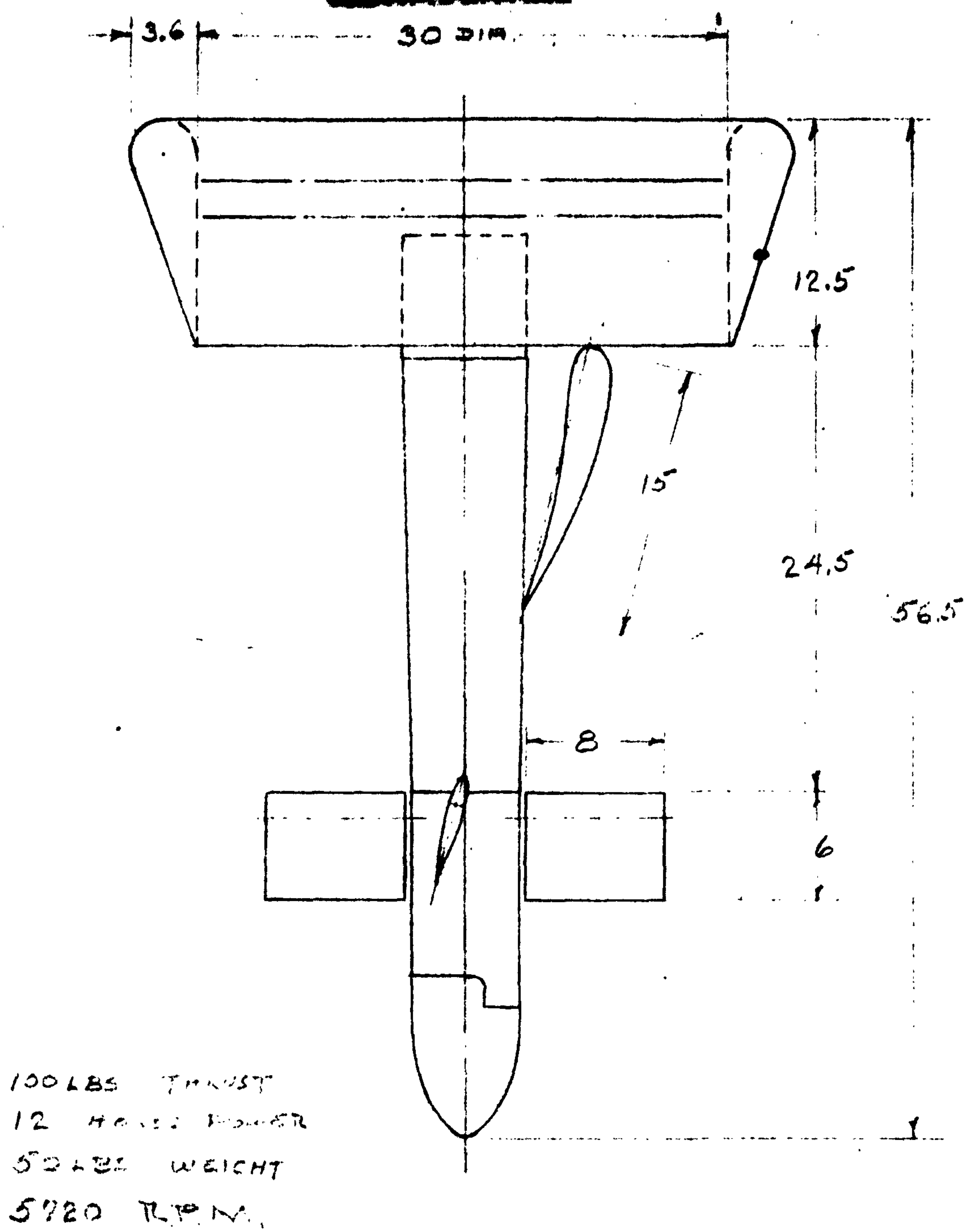

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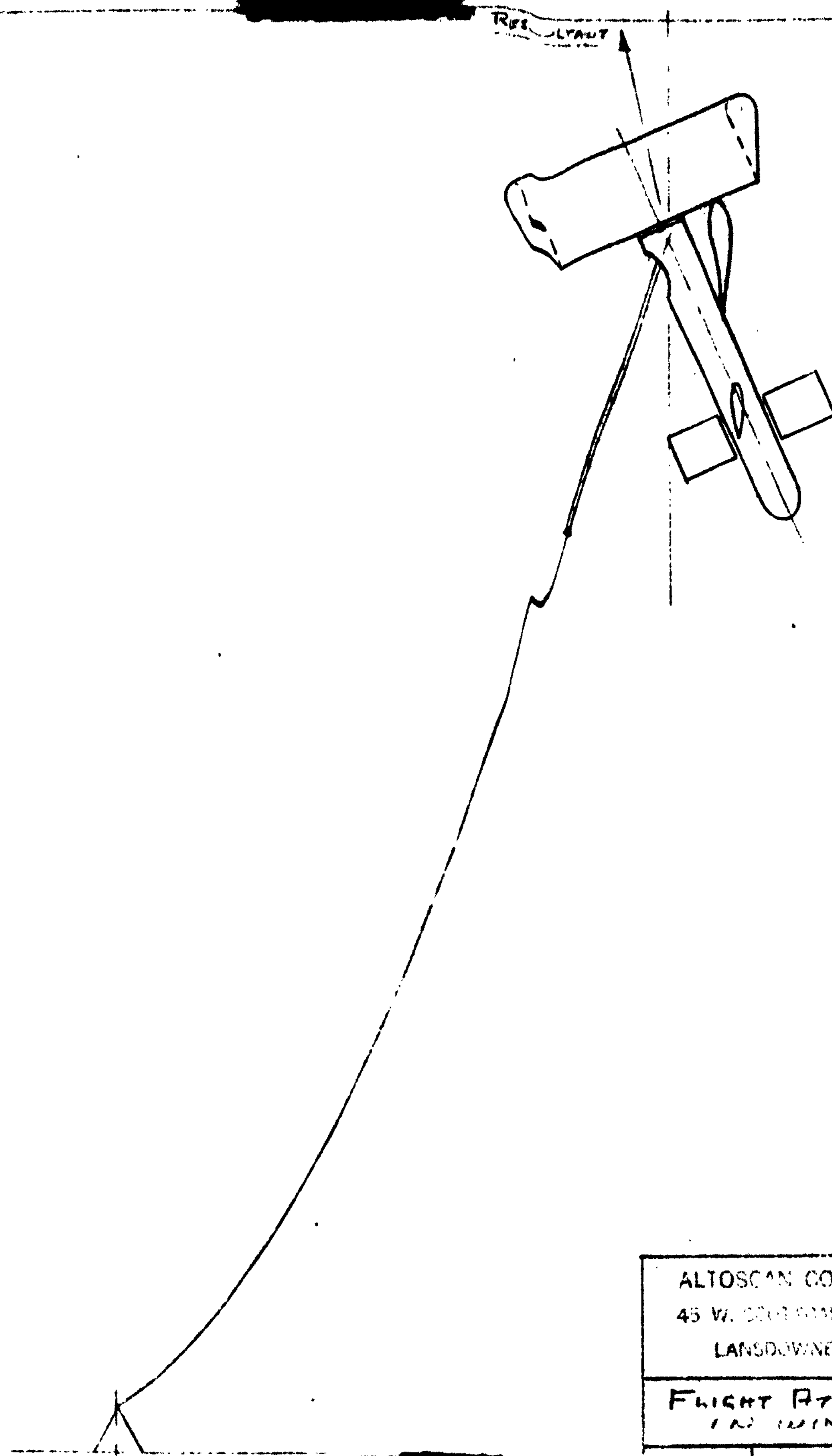

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FLIGHT ATTITUDES IN WIND

XA3-277

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